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(54) IMPROVEMENTS IN AND RELATING TO DISPENSING PUMPS

(71) We, LOUIS FRANK KUTIK, of 8720, S.W. 23rd Place, Fort Lauderdale, State of Florida, United States of America, and ERICH WALTER GRONEMEYER, of 3430, Galt Ocean Drive, Fort Lauderdale, State of Florida, United States of America, both citizens of the United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The present invention relates to dispensing pumps.

The type of pump with which the invention is concerned is often used to dispense liquid materials from a bottle or other container. By way of example, such pumps are sometimes used to dispense lotions, liquid detergents, syrups and similar materials. Known pumps of this type, however, have been sufficiently expensive to limit their use to some extent. One of the reasons for the relatively high cost of known pumps is that they have been made up of a large number of component parts, sometimes involving ball valves, springs, and mechanisms of various kinds. Not only are the parts costly to manufacture, but assembly of the parts to fabricate a complete pump involves considerable labor and, of course, this also adds to manufacturing cost.

According to the present invention a pump for dispensing liquids from a container comprises first and second parts assembled with each other and forming at least one compartment therein, said compartment having an inlet passage and an outlet passage communicating therewith, said first part being an actuator part, and said second part being a housing part having a substantially cylindrical surface, and a third part inside said compartment and having an integral portion forming an intake valve for said inlet passage, another integral portion having a free deflectible resilient circular edge yieldably engaging and self-biased against said substantially cylindrical surface and forming an outlet valve for said outlet passage, and still a further portion forming with said second housing part a seal blocking flow along a path between said valves when any of said valves is open. By substantially cylindrical we mean cylindrical or slightly tapered, e.g. frusto-conical.

A pump embodying the present invention is suitable for dispensing liquid material from a container, the pump comprising relatively few parts, all of which may be made from injection moulded plastics material. In a preferred embodiment, the pump consists of only three parts which can be assembled together by vertical stacking in a very simple manner to form a complete pump. In this embodiment, the parts are a housing and a closure for the housing assembled with each other to form a compartment, the closure including a diaphragm in the nature of a suction cup which can be depressed to expel liquid from the compartment, and which recovers or returns due to its elasticity to suck liquid into the compartment. The third part of the pump is a valve unit which has an intake valve portion and an exhaust valve portion. The housing has a bottom wall with a central opening therein forming an inlet passage, and also has a cylindrical surface in the nature of a counterbore with an outlet passage communicating with the interior of this cylindrical surface. The valve unit fits into the housing and has an annular flap constituting the exhaust valve with its outer circular edge contacting the cylindrical surface to divide the compartment into two chambers. The inlet passage communicates through the valve unit with one of these chambers, and the outlet passage communicates with the other chamber. The intake valve may be a flap located centrally within the exhaust valve in a position to cover the inlet passage. The two valves are separated by a seal portion of the valve unit.

When the diaphragm is depressed, it increases pressure in the first chamber to expel liquid therefrom past the circular edge of the exhaust valve flap and out through the outlet passage while at the same time closing the in-

[Price 25p]

38, the space 66 being interrupted only by the small joints 62 and 64. The joints 62 and 64 are thin enough to bend readily, and thus flap 58 can swing upwardly from a horizontal position after the pump is assembled as will be described.

Closure 14 includes the annular rim 30 mentioned previously, and also includes a diaphragm portion 68 which is shaped like a suction cup. Diaphragm 68 curves downwardly and outwardly to a circular ridge 70, and then curves outwardly and upwardly to the top of rim 30. Annular pleat portion 72 of the diaphragm acts like a hinge, and when diaphragm 68 is pushed downward, ridge 70 moves radially outwardly toward rim 30. Diaphragm 68 is elastic and has good recovery so that it will return by itself to its normal position after being depressed. Underneath diaphragm 68 are downwardly extending protrusions 74 arranged in a circular pattern, the protrusions being engageable with the flap 56 of the valve unit 16 when diaphragm 68 is depressed. The action of protrusions 74 will be explained more fully in connection with the operation of the pump.

As shown in Figure 2, the valve unit 16 is assembled with the housing 12 by placing the hollow stem 38 in the top of the recess 36, the valve unit 16 then being in the position shown in dashed lines in Figure 2. After thus assembling, valve unit 16 is pushed downwardly to force hollow stem portion 38 into recess 36 until the bottom of stem 38 butts against the bottom surface of recess 36. The circular edge 60 of flap 56 is inserted inside cylindrical surface 32 of bottom wall 20. The diameter of the cylindrical surface 32 is slightly smaller than the normal diameter of edge 60, and consequently flap 56 bends downwardly slightly when edge 60 is inserted into surface 32. Thus, flap 56 cannot easily be bent upwardly from the position shown in Figure 2, but it can bend downwardly from the position shown in Figure 2. As mentioned previously, flap 56 constitutes an exhaust valve, and the exhaust valve is closed with flap 56 in the position shown in Figure 2.

The closure 14 is assembled with housing 12 in the manner shown in Figure 3. Rim portion 30 is placed in the top of recess 38, and rim portion 30 is then forced downwardly until its bottom end butts against the bottom surface of recess 28 as shown in Figure 3. As thus assembled, the closure 14 and the housing 12 form a compartment which has a hollow interior. The interior of the compartment is divided by flap 56 into a lower chamber 76 and an upper chamber 78. Inlet passage 42 communicates with upper chamber 78 through valve flap 58 when the latter flap is open, and outlet passage 50 communicates with the lower chamber 76.

In connection with the assembling of the parts of the pump, it may be noted at this point that the assembling of the valve unit 16 and the closure unit 14 with the housing 12 may be accomplished in the following manner. Valve unit 16 may be placed over recess 36 with the stem 38 inserted therein, and closure 14 may be placed on the top of housing 12 with the rim 14 inserted slightly in recess 28. A plunger may then be brought down on rim portion 14 to force it fully into recess 28. Another plunger, concentrically within the first plunger, may then be brought down to depress diaphragm 68. As diaphragm 68 is depressed, protrusions 74 are directed outwardly at an angle, and they are also brought into contact with flap 56 of valve unit 16. The diaphragm contacts valve unit 16 and forces it into recess 36. At the same time, protrusions 74 force edge 60 of valve unit 16 inside circular surface 32. The pump is then fully assembled, and the plunger may be raised so that diaphragm 68 returns to its normal position.

Housing 12, closure 14 and valve unit 16 are each moulded integrally by injection moulding of plastics material. Housing 12 is preferably moulded of a relatively stiff plastics material such as polypropylene or polyethylene. On the other hand, closure 14 and valve unit 16 are preferably moulded of a softer plastics material such that the valves 56 and 58 and the diaphragm 68 are resiliently flexible. Diaphragm 68 in particular should have good elasticity and recovery so that it can be depressed and will return to its normal position. Annular seat surface 54 which extends about inlet passage 42 and also circular edge 60 of valve flap 56 must be formed accurately to insure that good seals are provided at these points. In the moulding of valve unit 16, it is thus preferable that the moulds do not part at the circular edge 60, because this would leave a mould line at edge 60. Rather, the mould may be undercut so that edge 60 is formed accurately, and the mould may part somewhere along a surface of flap 56 removed from edge 60. Similarly, the annular seat surface 54 should be formed by a continuous surface of the mould.

It may be noted that there are no springs or other metal parts in the pump. The only spring action of the valves 56 and 58 is derived from the resiliency of the plastics material from which the valve unit 16 is moulded.

As has been pointed out, the rim 30 of closure 14 in the illustrated embodiment fits tightly with walls 18 and 26 in the recess 28 of housing 12. The closure may be secured to the housing in other ways. For example, the top of wall 18 may be riveted or spun over the top of rim 30 to hold the rim in place. Alternatively, a ring-shaped recess may be formed in wall 18 and a matching protruding ring may be formed on the side of rim 30 so that the protruding ring snaps into the

recess when the closure is assembled with the housing. Snap fitting closures of this type are well known.

Figure 6 and 7 illustrate the manner in which the pump 10 operates. Figure 6 shows how liquid is expelled or dispensed from the pump. It will be assumed that the upper chamber 78 inside housing 12 is initially filled with liquid. Actuating force applied to the exterior of diaphragm 68, as by pressing on the diaphragm with one's finger, applies increased pressure to the liquid in chamber 78. This pressure forces yieldable circular edge 60 downwardly and away from surface 32. Thus, liquid is expelled from chamber 78 past edge 60 of valve flap 56 into chamber 76 and from there through outlet passage 50 and out of nozzle 48. At the same time, the pressure in chamber 78 forces intake valve flap 58 against annular seat surface 54 to close the inlet passage 42.

It may be seen from Figure 6 that when diaphragm 68 is fully depressed, the centre of the diaphragm pushes stem 38 of valve unit 16 downwardly, and projections 74 slant outwardly and engage flap 56. Thus, if valve unit 16, or just the flap 56 thereof, were out of position prior to a dispensing stroke, diaphragm 68 will push the valve unit or just flap 56 back into place as the diaphragm is depressed.

When the actuating force is released, diaphragm 68 moves outwardly in the manner shown in Figure 7 and returns to its original position. This produces suction in chamber 78 which pulls intake valve flap 58 upwardly off seating ring 54 to thereby open inlet passage 42. The reduced pressure in chamber 78 sucks liquid from the container with which the pump is associated through inlet passage 42 into chamber 78, thus refilling this chamber. The suction in chamber 78 also pulls exhaust valve flap 56 upwardly and urges circular edge 60 against surface 32. This closes the exhaust valve so that no liquid escapes through outlet passage 50. It may be noted that hollow cylindrical stem 38 of valve unit 16 forms a seal between intake valve flap 58 and exhaust valve flap 56 so that there is no way for liquid to leak directly from inlet passage 42 to outlet passage 50.

Annular pleat portion 72 of diaphragm 68 acts as a hinge and swings outwardly as diaphragm 68 is depressed, thus allowing diaphragm 68 to flatten out when it is fully depressed, or at least become flatter. Portion 72 is resilient, and so returns to its initial position when actuating force is released from the diaphragm.

It may be seen from the foregoing description that pump 10 consists of a minimum number of parts, only three parts being provided in the illustrated embodiment. These parts can all be molded by injection moulding in an economical manufacturing process. The pump is simple and it can operate reliably despite the fact that it is inexpensive.

WHAT WE CLAIM IS:—

1. A pump for dispensing liquids from a container comprising first and second parts assembled with each other and forming at least one compartment therein, said compartment having an inlet passage and an outlet passage communicating therewith, said first part being an actuator part, and said second part being a housing part having a substantially cylindrical surface, and a third part inside said compartment and having an integral portion forming an intake valve for said inlet passage, another integral portion having a free deflectible resilient circular edge yieldably engaging and self-biased against said substantially cylindrical surface and forming an outlet valve for said outlet passage, and still a further portion forming with said second housing part a seal blocking flow along a path between said valves when any of said valves is open.

2. A pump as claimed in Claim 1 in which said second part comprises a housing having a bottom wall with a central aperture therein forming said inlet passage, and also having an annular upstanding wall portion in the interior thereof concentric with said aperture and having formed on the inside thereof said substantially cylindrical surface yieldably engaged by said circular edge.

3. A pump as claimed in Claim 2 in which said outlet valve is a flap which divides said compartment into an input chamber and an output chamber, said inlet passage communicates with said input chamber and said outlet passage communicates with said output chamber.

4. A pump as claimed in claim 3 in which said substantially cylindrical surface is cylindrical and has a slightly smaller diameter than said circular edge of said outlet valve flap to bend said flap inwardly slightly to form a peripheral seal, said circular edge decreasing in diameter substantially uniformly to open said outlet valve in response to operation of said actuator part to expel fluid.

5. A pump as claimed in any of claims 1 to 4 in which said parts are made of injection moulded plastics material.

6. A pump as claimed in any preceding claim in which said actuator part includes a diaphragm portion.

7. A pump as claimed in claim 6 in which said actuator part also includes a rim portion forced between wall portions of said housing part, and a hinge portion connecting said diaphragm portion to said rim portion.

8. A pump as claimed in claim 7 in which said hinge portion is an annular pleat.

9. A pump as claimed in claim 4 and in claims 6, 7 or 8 in which said diaphragm portion is engageable with said outlet valve flap when said diaphragm portion is depressed

thereby ensuring that said outlet valve flap is positioned inside said cylindrical surface.

10. A pump as claimed in claim 9 in which said diaphragm portion has projections for engaging said outlet valve flap.

11. A pump as claimed in any preceding claim, in which the resilient circular edge of said third part is free of any mould parting line.

12. A pump as claimed in any preceding claim in which the integral portion of said third part forming said intake valve is a second flap portion which is located substantially centrally of said third part and hingedly connected thereto and is adapted to block the inlet passage when the intake valve is closed and to swing off an inlet valve seat to open the intake passage.

13. A pump for dispensing liquid from a container, comprising a housing and a closure for the housing assembled with each other to form a compartment having an inlet passage and an outlet passage both communicating therewith, an intake valve for said inlet passage, an outlet valve for said outlet passage, said compartment having a substantially cylindrical surface therein, said outlet valve comprising a resiliently flexible flap having a circular edge engaging said cylindrical surface and slightly larger in diameter than said cylindrical surface so that said flap bends slightly and is self biased against said cylindrical surface, said flap dividing the interior of said compartment into an input chamber with which said inlet passage communicates and an output chamber with which said outlet passage communicates, and said closure for the housing including an actuator depressible into said input chamber to expel liquid therefrom past said flap through said output chamber and out through said outlet passage, said actuator being returnable to suck liquid through said inlet passage past said intake valve into said input chamber.

14. A liquid dispensing pump constructed and arranged and adapted to be operated substantially as hereinbefore particularly described with reference to and as illustrated in the accompanying drawings.

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1262528 COMPLETE SPECIFICATION
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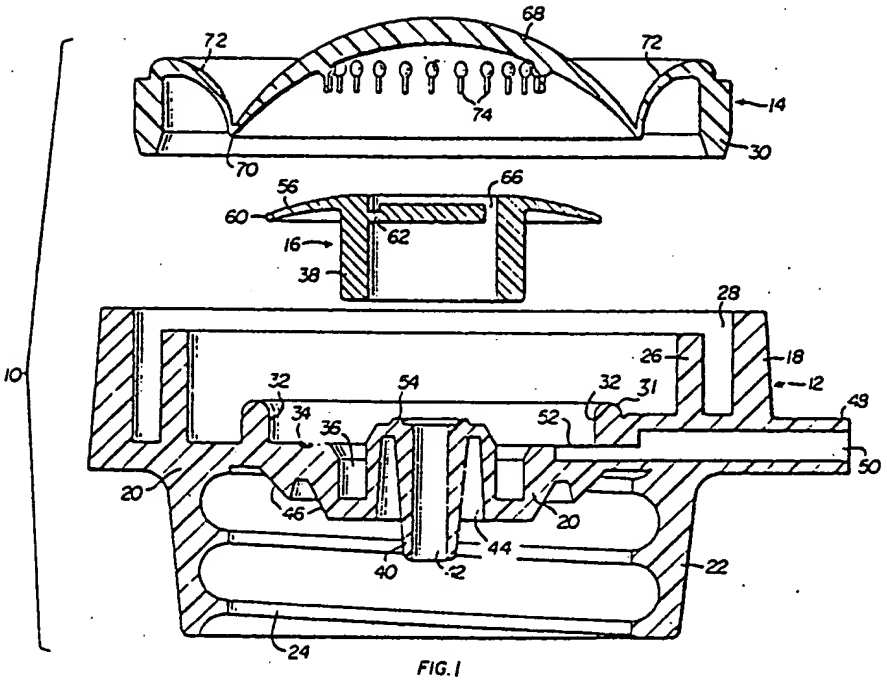

FIG. 1

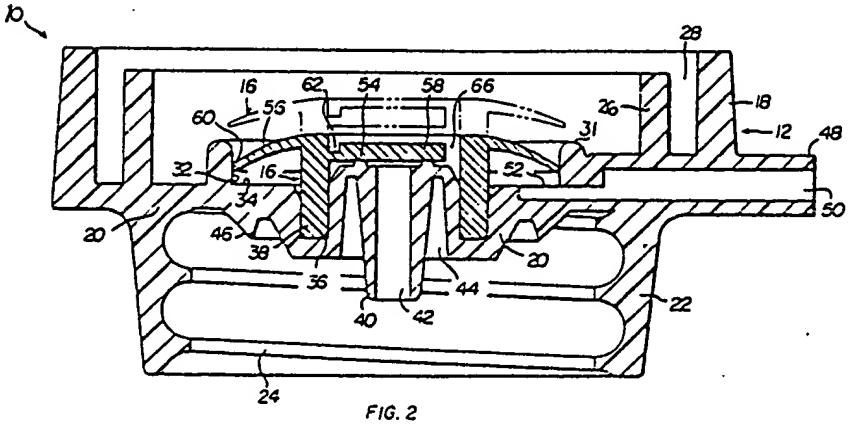

FIG. 2

1262528 COMPLETE SPECIFICATION
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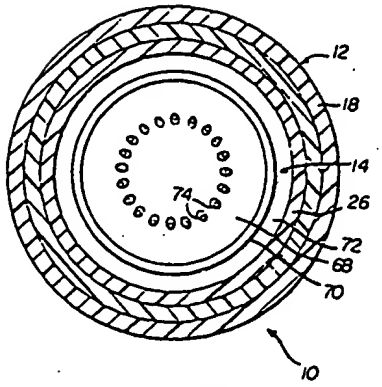

FIG. 4

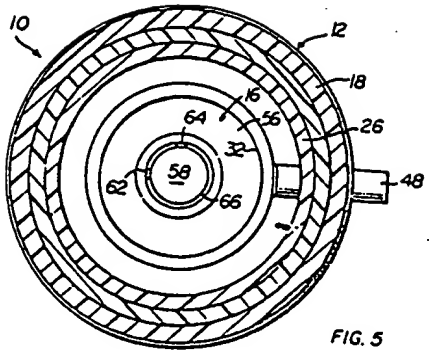

FIG. 5

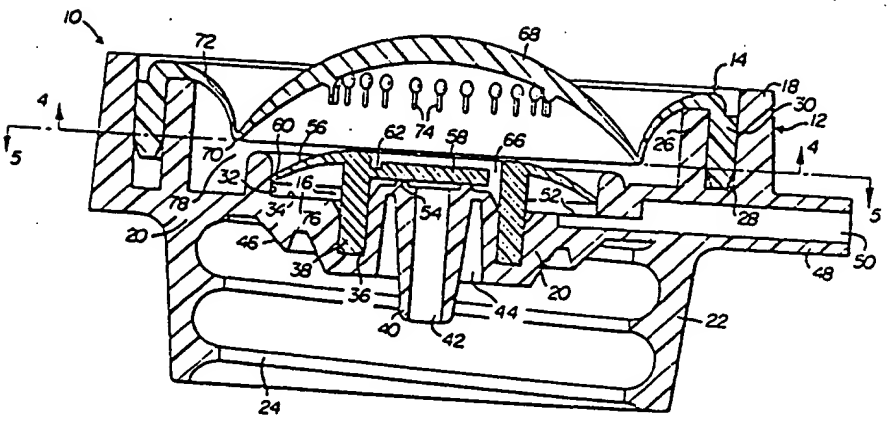

FIG. 3

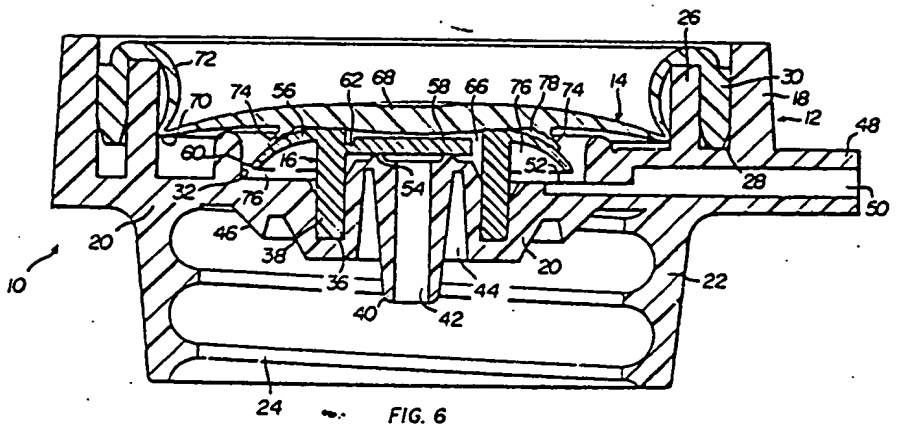
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FIG. 6

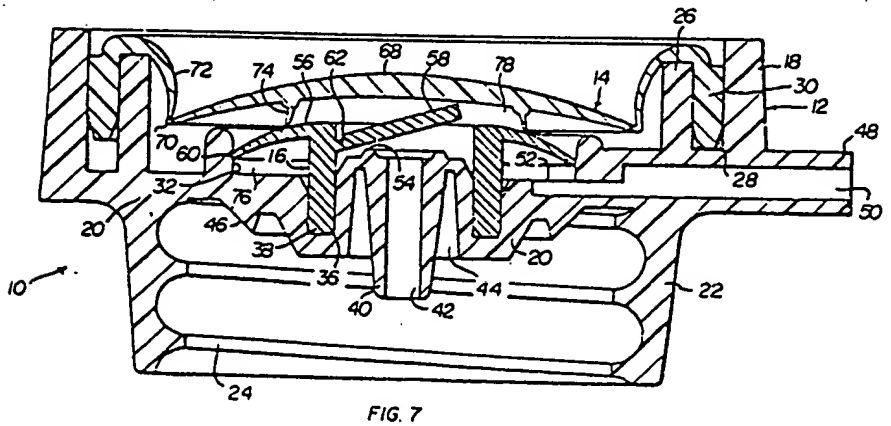
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FIG. 7

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